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(54) A FUEL PUMP UNIT FOR A FUEL DISPENSING UNIT, A FUEL DISPENSING UNIT FOR REFUELLING A VEHICLE , AND A METHOD FOR HANDLING A FUEL PUMP UNIT FOR A FUEL DISPENSING UNIT

(57) The invention relates to a fuel pump unit (10) for a fuel dispensing unit (1). The fuel pump unit (10) comprises a pump (6) with a suction side (S) and a pressure side (P), a variable-speed pump motor (11) adapted to drive the pump (6), a bypass channel (12) arranged between the pressure side (P) and the suction side (S) of the pump (6), a flow meter (13) arranged at the pressure side (P) of the pump (6) downstream of the bypass channel (12), and a control unit (14) connected to the variable-speed pump motor (11) and the flow meter (13). The fuel pump unit (10) is characterised in that the control unit (14) is adapted to control the speed of the variable-speed pump motor (11) based on a fuel flow rate detected by the flow meter (13). The invention also relates to fuel dispensing unit (1) for refuelling a vehicle and a method for handling a fuel pump unit (10) for a fuel dispensing unit (1).

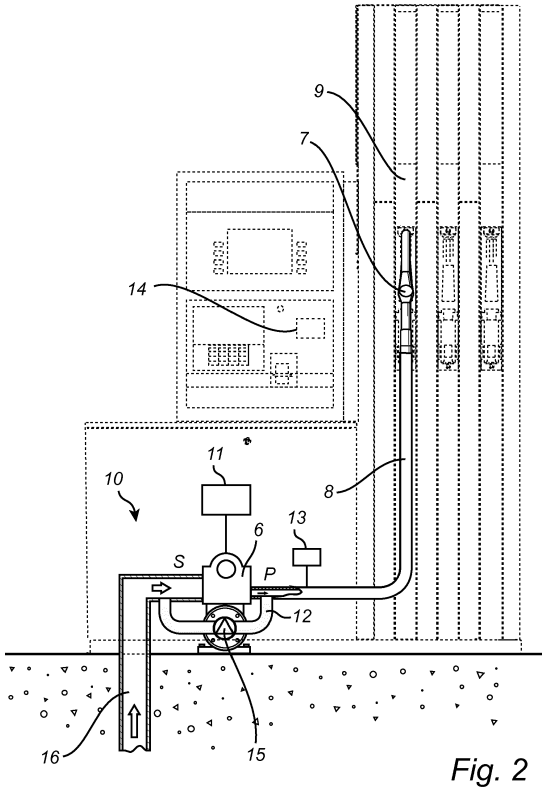

Fig. 2

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Description

Technical field

[0001] The invention relates to a fuel pump unit for a fuel dispensing unit, a fuel dispensing unit for refuelling a vehicle and a method for handling a fuel pump unit for a fuel dispensing unit.

Background art

[0002] In retail service station environments, a submersible turbine pump associated with an underground storage tank is often used to pump fuel to one or more fuel dispensers. However, some fuel dispensers comprise a self-contained pumping unit, meaning fuel is drawn to the fuel dispenser by a motor-driven pump positioned within the fuel dispenser housing. Where multiple grades of fuel are dispensed, these fuel dispensers typically comprise a self-contained pump for each grade of fuel. Often, these pumps are sliding vane pumps or gear pumps and are driven by a motor which operates at a fixed speed.

[0003] A fuel dispenser having an integrated pump normally comprises a bypass spring valve arranged between the suction side and the pressure side of the pump. The pump is driven by a motor which operates at a fixed speed. In one mode of operation, the pump is used in a fuel dispenser to supply fuel to two or more nozzles for delivering the same grade of fuel. The pump is designed to produce a fuel stream having a sufficient pressure to allow simultaneous fuelling from the two or more nozzles at a desirable flow rate. During simultaneous fuelling, the bypass valve is closed or open at a small opening degree. However, when the fuel dispenser is used to deliver fuel from only one nozzle, a backpressure develops and causes the bypass valve to open. Thereby, a portion of the pumped fuel is recirculated to the inlet of the pump.

[0004] Since the motor pump operates at a fixed speed independent of one or several nozzles are in operation, this solution provides for an elevated temperature over the bypass valve when fuel is pumped from only one nozzle. In turn, this will lead to a high energy consumption of the fuel dispenser.

Summary of the invention

[0005] It is an objective of the present invention to provide an improvement of the above technique and prior art. More particularly, it is an objective of this invention to provide an improved fuel pump unit with a decreased energy consumption.

[0006] According to a first aspect, these and other objects, and/or advantages that will be apparent from the following description of embodiments, are achieved, in full or at least in part, by a fuel pump unit for a fuel dispensing unit. The fuel pump unit comprises a pump with a suction side S and a pressure side P, a variable-speed pump motor adapted to drive the pump, a bypass channel arranged between the pressure side P and the suction side S of the pump, a flow meter arranged at the pressure side P of the pump downstream of the bypass channel, and a control unit connected to the variable-speed pump motor and the flow meter. The pump unit is characterised in that the control unit is adapted to control the speed of the variable-speed pump motor based on a fuel flow rate detected by the flow meter.

[0007] This way, the speed of the variable-speed pump motor will be continuously adjusted in relation to the application level of the fuel dispensing unit. In turn, the fuel that will be forced to circulate through the bypass channel of the fuel pump unit during refuelling will be kept to a minimum.

[0008] This is advantageous in that the loss of energy due to an elevated temperature over the bypass valve in the bypass channel will be minimized and thus the overall energy consumption of the system will be decreased.

[0009] The control unit may be adapted to increase the speed of the variable-speed pump motor upon an increase of the fuel flow rate detected by the flow meter.

[0010] The control unit may be adapted to set the variable-speed pump motor at a speed such that an overcapacity at the pressure side (P) of the pump is established.

[0011] The control unit may be in electronic communication with the variable-speed pump motor and the flow meter.

[0012] The bypass channel may comprise a bypass control valve, which control valve may comprise a spring valve.

[0013] The pump may be a suction pump.

[0014] The variable-speed pump motor may be a step motor or a brushless DC motor.

[0015] The fuel pump unit may further comprise an air separating device adapted to remove air present in the fuel flowing through the fuel pump unit.

[0016] According to a second aspect, these and other objects are achieved, in full or at least in part, by a fuel dispensing unit for refuelling a vehicle, which comprises a fuel pump unit according to the features described above.

[0017] According to a third aspect, these and other objects are achieved, in full or at least in part, by a method for handling a fuel pump unit for a fuel dispensing unit. The fuel pump unit comprises a pump with a suction side S and a pressure side P, a variable-speed pump motor adapted to drive the pump, a bypass channel arranged between the pressure side P and the suction side S of the pump, a flow meter arranged at the pressure side P of the pump downstream of the bypass channel, and a control unit connected to the variable-speed pump motor and the flow meter. The method is characterised by the step of controlling the speed of the variable-speed pump motor based on a fuel flow rate detected by the flow meter.

[0018] The step of controlling the speed of the variable-

speed pump motor may comprise increasing the speed of the variable-speed pump motor upon an increase of the fuel flow rate detected by the flow meter.

[0019] The step of controlling the speed of the variable-speed pump motor may comprise setting the variable-speed pump motor at a speed such that an overcapacity at the pressure side P of the pump is established

[0020] Effects and features of the second and third aspect of the present invention are largely analogous to those described above in connection with the first aspect of the inventive concept. Embodiments mentioned in relation to the first aspect of the present invention are largely compatible with the further aspects of the invention.

[0021] Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached claims, as well as from the drawings. It is noted that the invention relates to all possible combinations of features.

[0022] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc.]" are to be interpreted openly as referring to at least one instance of said element, device, component, means, step, etc., unless explicitly stated otherwise.

[0023] As used herein, the term "comprising" and variations of that term are not intended to exclude other additives, components, integers or steps.

Brief description of the drawings

[0024] The above, as well as additional objects, features and advantages of the present invention, will be better understood through the following illustrative and non-limiting detailed description of embodiments of the present invention, with reference to the appended drawings, where the same reference numerals may be used for similar elements, and wherein:

Fig. 1 is a schematic view of an exemplary embodiment of a fuel dispensing unit according to a second aspect of the invention.

Fig. 2 is a cross sectional view of an exemplary embodiment of a fuel pump unit according to a first aspect of the invention for the fuel dispensing unit in Fig. 1.

Detailed description of preferred embodiments of the invention

[0025] Fig. 1 illustrates an exemplary fuel dispensing unit 1, having hose storage spaces 2 on each opposing side of the fuel dispensing unit 1, an electrical cabinet 3 containing all the electronics for the fuel dispensing unit 1, a hydraulic cabinet 4 containing fuel dispensing means (not shown), e.g. fuel metering means, valves, vapour recovery system etc., and a column 5 extending vertically between and separating the electrical cabinet 3 and the hydraulic cabinet 4 from the hose storage spaces 2.

[0026] The fuel dispensing unit 1 is connected to an underground reservoir (not shown) containing fuel. When filling up the tank of a motor vehicle, the fuel is pumped from the underground reservoir by means of a pump 6 which is located in the hydraulic cabinet 4, and from there to the column 5 and out to a nozzle 7 via a hose 8.

[0027] The fuel dispensing unit has a nozzle boot 9 in which the nozzle 7 is arranged when not in use. The nozzle boot 9 preferably comprises a sensor (not shown) for detecting if the nozzle 7 is present in the nozzle boot 9. Further, the nozzle 7 is normally equipped with a flow meter (not shown) for measuring the fuel flow rate from the nozzle 7 upon refuelling.

[0028] In Fig. 2, an exemplary embodiment of a fuel pump unit 10 for the fuel dispensing unit 1 is illustrated. The fuel pump unit 10 comprises the pump 6 with the suction side S and the pressure side P, a variable-speed pump motor 11 adapted to drive the pump 6, a bypass channel 12 arranged between the pressure side P and the suction side S of the pump 6, a flow meter 13 arranged at the pressure side P of the pump downstream of the bypass channel 12, and a control unit 14 connected to the variable-speed pump motor 11 and the flow meter 13. The bypass channel 12 has a control valve 15 comprising a spring valve.

[0029] The fuel pump unit 10 further comprises an air separating device (not shown) adapted to remove air present in the fuel flowing through the fuel pump unit 10.

[0030] A main fuel supply pipe 15 extends between the underground reservoir and the suction side S of the pump 6, while the hose 8 extends between the pressure side P of the pump 6 and the nozzle 7. The suction side S provides an underpressure to the main fuel supply pipe 15 and the pressure side S provides an overpressure to the hose 8.

[0031] The control unit 14 is adapted to control the speed of the variable-speed pump motor 11 based on a fuel flow rate detected by the flow meter 13. This is conducted by increasing the speed of the variable-speed pump motor 11 upon an increase of the fuel flow rate detected by the flow meter 13. Preferably, the variable-speed pump motor 11 is set at a speed such that an overcapacity at the pressure side P of the pump 6 is established. Due to the fact that the speed of the variable-speed pump motor 11 is variated instead of continuously operating at a fixed speed, the overall energy consumption of the fuel pump unit 10 will be even further decreased.

[0032] One exemplary method of handling the fuel pump unit 10 in the fuel dispensing unit 1 will now be described in detail with reference to the embodiment illustrated in Fig. 2.

[0033] When the nozzle 7 is removed from the nozzle boot 9, the control unit 14 is alerted and a variable-speed pump motor 11 driving the pump 6 is started at a low speed. Since the actual refuelling has not been started

at this stage, the fuel is now circulated from the pressure side P to back to the suction side S via the bypass channel 12.

[0034] When the nozzle 7 is opened and the fuel starts flowing therefrom, a pressure drop will occur and the pressure from the fuel applied on the spring valve 15 in the bypass channel 12 will decrease. Now, the fuel will instead flow through the hose 8 and out of the nozzle 7 for delivery to a vehicle. When the fuel flow rate through the flow meter 13 is at the maximum fuel flow rate that can be delivered at the current speed of the variable-speed pump motor 11, the control unit 14 will increase the speed of the variable-speed pump motor 11. The control unit 14 will constantly monitor the refuelling process and adjust the speed of the variable-speed pump motor 11 based on the fuel flow rate detected by the flow meter 13 to create a constant overcapacity in the pump pressure. This way, there will also be a small but constant circulation of fuel through the bypass channel 12.

[0035] The skilled person realizes that a number of modifications of the embodiments described herein are possible without departing from the scope of the invention, which is defined in the appended claims.

[0036] For instance, the variable speed pump motor 11 can for example be a two-step motor which operates at a speed of 500 rpm/1000 rpm. Naturally, other variants are also possible. More steps equal a higher degree of fine tuning of the variable speed pump motor 11 in relation to the fuel flow rate detected by the flow meter 13.

[0037] The control unit 14 can be arranged to gather user information and over time create a table based on experience which in turn can be used to fine adjust the appropriate initial fuel flow rate during refuelling.

Claims

1. A fuel pump unit (10) for a fuel dispensing unit (1), comprising
   a pump (6) with a suction side (S) and a pressure side (P),
   a variable-speed pump motor (11) adapted to drive the pump (6),
   a bypass channel (12) arranged between the pressure side (P) and the suction side (S) of the pump (6),
   a flow meter (13) arranged at the pressure side (P) of the pump (6) downstream of the bypass channel (12), and
   a control unit (14) connected to the variable-speed pump motor (11) and the flow meter (13),
   characterised in that the control unit (14) is adapted to control the speed of the variable-speed pump motor (11) based on a fuel flow rate detected by the flow meter (13).

2. The fuel pump unit (10) according to claim 1, wherein the control unit (14) is adapted to increase the speed of the variable-speed pump motor (11) upon an increase of the fuel flow rate detected by the flow meter (13).

3. The fuel pump unit (10) according to claim 1 or 2, wherein the control unit (14) is adapted to set the variable-speed pump motor (11) at a speed such that an overcapacity at the pressure side (P) of the pump (6) is established.

4. The fuel pump unit (10) according to any one of the preceding claims, wherein the control unit (14) is in electronic communication with the variable-speed pump motor (11) and the flow meter (13).

5. The fuel pump unit (10) according to any one of claims 1-4, wherein the control unit (14) is in wireless communication with the variable-speed pump motor (11) and the flow meter (13).

6. The fuel pump unit (10) according to any one of the preceding claims, wherein the bypass channel (12) comprises a bypass control valve (15).

7. The fuel pump unit (10) according to claim 6, wherein the bypass control valve (15) is a spring valve.

8. The fuel pump unit (10) according to any one of the preceding claims, wherein the pump (6) is a suction pump.

9. The fuel pump unit (10) according to any one of the preceding claims, wherein the variable-speed pump motor (11) is a step motor.

10. The fuel pump unit (10) according to any one of claims 1-9, wherein the variable-speed pump motor (11) is a brushless DC motor.

11. The fuel pump unit (10) according to any one of the preceding claims, further comprising an air separating device adapted to remove air present in the fuel flowing through the fuel pump unit (10).

12. A fuel dispensing unit (1) for refuelling a vehicle, comprising a fuel pump unit (10) according to any one of the claims 1-11.

13. A method for handling a fuel pump unit (10) for a fuel dispensing unit (1), the fuel pump unit (10) comprising
   a pump (6) with a suction side (S) and a pressure side (P),
   a variable-speed pump motor (11) adapted to drive the pump (6),
   a bypass channel (12) arranged between the pressure side (P) and the suction side (S) of the pump (6),
   a flow meter (13) arranged at the pressure side (P) of the pump (6) downstream of the bypass channel

(12), and
a control unit (14) connected to the variable-speed pump motor (11) and the flow meter (13),
characterised by the step of controlling the speed of the variable-speed pump motor (11) based on a fuel flow rate detected by the flow meter (13).

14. The method according to claim 13, wherein the step of controlling the speed of the variable-speed pump motor (11) comprises increasing the speed of the variable-speed pump motor (11) upon an increase of the fuel flow rate detected by the flow meter (13).

15. The method according to claim 13 or 14, wherein the step of controlling the speed of the variable-speed pump motor (11) comprises setting the variable-speed pump motor (11) at a speed such that an over-capacity at the pressure side (P) of the pump (6) is established.

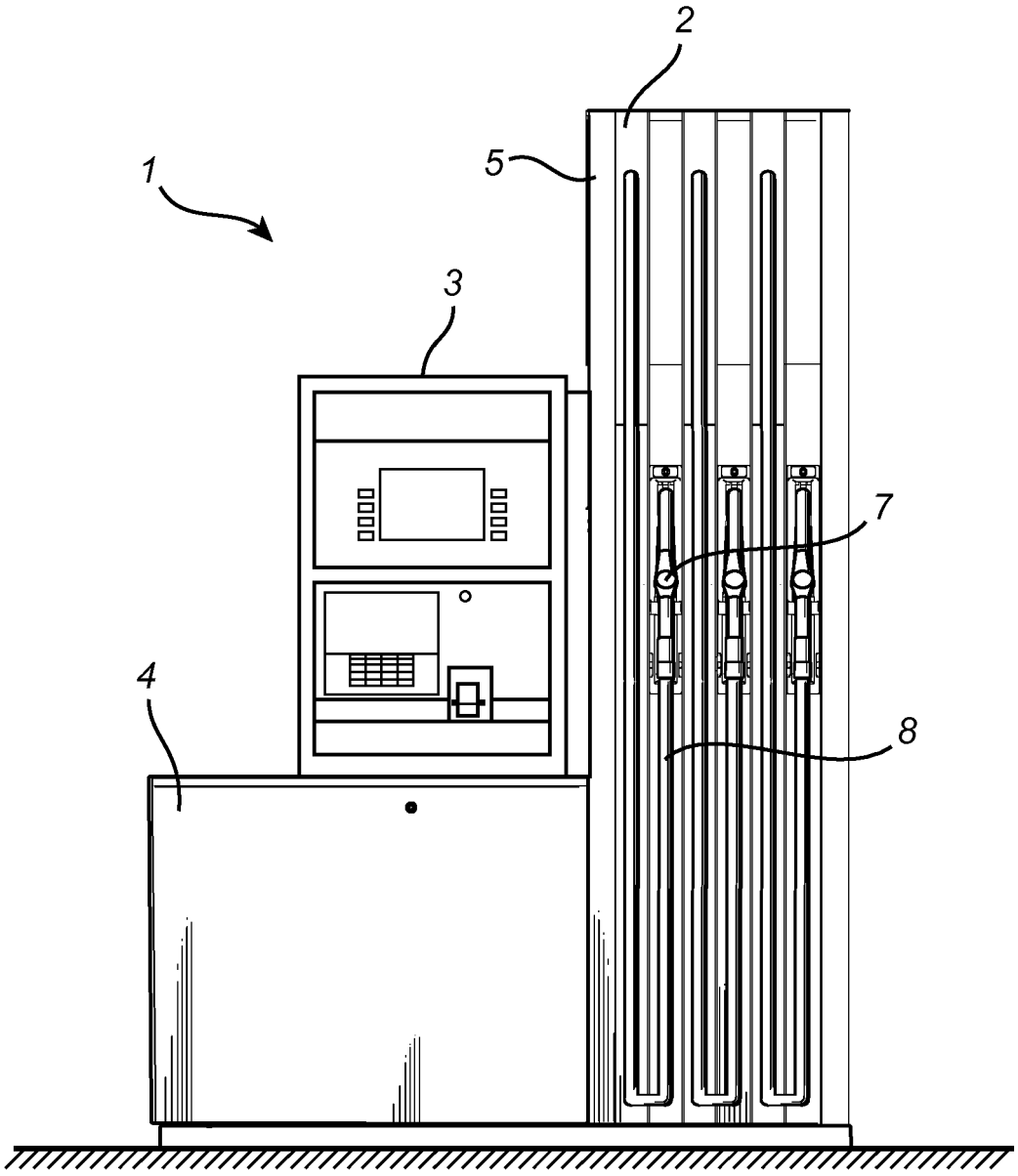

Fig. 1

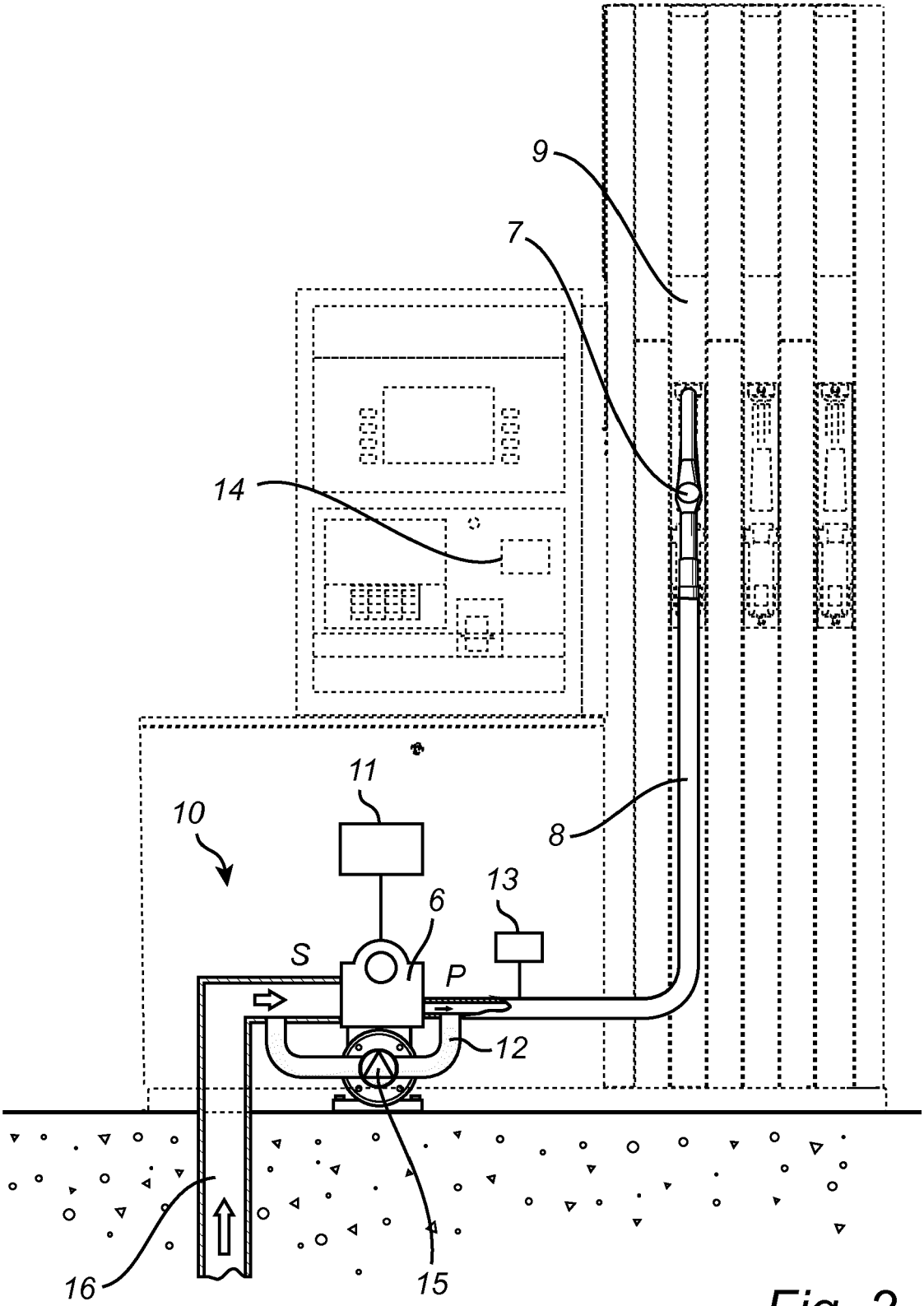

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 17 16 8774

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2015/187976 A2 (GILBARCO INC [US]) 10 December 2015 (2015-12-10) * page 3, line 14 - page 5, line 3 * * page 8, line 1 - line 21 * * page 11, line 18 - page 13, line 2 * * page 19, line 23 - page 20, line 8 * * page 22, line 18 - page 23, line 11 * * page 24, line 5 - line 13 * * page 26, line 6 - page 27, line 21 * * page 29, line 15 - line 19 * * page 30, line 14 - page 32, line 25 * * figures 2, 7, 21, 24 *	1-15	INV. B67D7/04 B67D7/08 B67D7/36 B67D7/76
A	EP 0 440 845 A1 (SCHEIDT & BACHMANN GMBH [DE]) 14 August 1991 (1991-08-14) * column 4, line 25 - column 6, line 19 * * figure 1 *	1,13	
			TECHNICAL FIELDS SEARCHED (IPC)
			B67D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 October 2017	Schultz, Tom

CATEGORY OF CITED DOCUMENTS

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